UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION IX
75 Hawthorne Street
San Francisco, CA 94105-3901

July 28, 1998

Baldwin Park Operable Unit Steering Committee
c/o Donald E. Vanderkar
Aerojet General Corporation
Box 13222
Sacramento, CA 95813

Subject: EPA Review of 20 May 1998 Phase 1 Treatability Study Draft Report and Phase 2 Treatability Study Work Plan, Baldwin Park Operable Unit, San Gabriel Basin

Dear Mr. Vanderkar:

We have completed our review of the Draft Perchlorate Treatability Study Phase 1 Report and Phase 2 Workplan, prepared by Harding Lawson Associates for the Baldwin Park Operable Unit Steering Committee. The full titles of the reports are:

> Phase 1 Treatability Study Draft Report, Perchlorate in Groundwater, Baldwin Park Operable Unit, San Gabriel Basin, 20 May 1998; and
>
> Phase 2 Treatability Study Work Plan, Perchiorate in Groundwater, Baldwin Park Operable Unit, San Gabriel Basin, 20 May 1998.

Our enclosed comments incorporate observations and suggestions made by EPA staff, as well as Metropolitan Water District (Metropolitan), the California Department of Health Services (DHS), and McGuire Environmental Consultants (consultant to the Main San Gabriel Basin Watermaster). We understand that Metropolitan, DHS, and McGuire Environmental Consultants have sent their comments directly to the Steering Committee. Metropolitan's comments are dated 9 and 22 June 1998; DHS's comments are dated 10 July 1998; and McGuire Environmental Consultants' comments are dated 12 June 1998.

The Phase 1 results are promising. The Phase 1 study appears to have met its primary goal of demonstrating that the biological process is capable of reducing perchlorate concentrations from the tens of ug/l to below 4 ug/l. More work must be completed, however, to convincingly demonstrate that the process can produce water that reliably meets all State and Federal water quality standards.

Please submit a revised Phase 1 report and Phase 2 workplan within 21 days of receipt of these comments. As we have discussed, the revised Phase 1 report should include data collected after 13 March 1998, the last date for data included in the draft report.

Sincerely,

Wayne Praskins
EPA Project Manager

Enclosure

cc: Rick Sakaji, DHS
Nabil Saba, DHS
Gary Yamamoto, DHS
Jeanne-Marie Bruno, Metropolitan Water District
Carol Williams, Main San Gabriel Basin Watermaster
Mike McGuire, McGuire Environmental Consultants
Michael Berlien, La Puente Valley County Water District
John Catts, Harding Lawson Associates

7/28/98 EPA Comments on
Phase 1 Treatability Study Draft Report, Perchlorate in Groundwater, Baldwin Park Operable Unit, San Gabriel Basin

Location	Comment
page v, 5th bullet [and p13, last sentence]	This finding should be rewritten, since the Phase 1 study did not include testing of filtration or disinfection processes, and did not appear to include analysis for all Title 22 water quality parameters. More work is needed to demonstrate that the treatment process will reliably produce potable water meeting all current and anticipated drinking water standards.
p3, § 2.4	The text states that pilot-scale work at Aerojet's Sacramento facility demonstrated that pathogens were not present in the pilot plant effluent. What analyses were conducted to support this statement?
p4, §3.0, ¶ 4	Please explain the operation of the biological growth control system and carbon capture and return system in more detail. Were waste solids produced in the Phase 1 study? If so, what was its composition, rate of production, and methods of handling and disposal? If no waste solids were produced, what was the fate of the carbon lost from the bioreactor (as described on page C-3)?
p5, § 4.0	In a few cases, perchlorate concentrations in the bioreactor increase slightly from one sampling location to the next (e.g., between sampling ports E and F on 2/18 and 2/20, and between ports F and G on 12/18 and 2/17). Do you think the increase is real? What data are available to support one explanation over another? (e.g., analytical error? incomplete mixing within the bioreactor? desorption from carbon?) Were replicate samples analyzed to estimate the precision of the perchlorate analyses? What and where are the results? What data are available to evaluate how well-mixed the groundwater is as it passes through the bioreactor? Could there be significant variability in microbial activity, flow, or perchlorate concentration perpendicular to the direction of flow? Do the sampling ports draw water from deep within the bioreactor (i.e., near the center), or close to the bioreactor wall? Also, measured perchlorate influent concentrations (pre-recycle) vary day to day, oftentimes by more than 20% (e.g., 51 to 36 ug/l, 57 to 35 ug/l, 39 to 27 ug/l). In contrast, nitrate concentrations varied little. Do you believe that this variability is real? Or due to analytical error or some other cause?

p6, § 5.1	Is there any experimental basis for the equation describing the reduction of perchlorate? Other researchers report that the conversion of perchlorate to chloride primarily occurs through the reduction of perchlorate to chlorate and chlorite, followed by the dismutation of chlorite: $ClO_4^- + 2e^- + 2H^+ \Rightarrow ClO_3^- + H_2O$ $ClO_3^- + 2e^- + 2H^+ \Rightarrow ClO_2^- + H_2O$ $ClO_2^- \Rightarrow O_2 + Cl^-$ Also, the text states the following: "Note that nitrate and perchlorate are completely destroyed..." The ability to write a balanced chemical reaction does not guarantee that the reaction will go to completion or that there aren't other competing reactions with other products.
p6, § 5.2	The text provides an equation for estimating effluent substrate concentration (S_e). How was this relationship used? If it was used, how were the parameters determined and what were their values?
p7, § 5.3	Please discuss the quality of the data generated as part of the study, with reference to the quality control analyses. Were the BOD or COD data evaluated? If so, for what purpose?
p8, § 5.3.2, ¶ 2	Please clarify the statement that "...most of the nitrate is 25% destroyed..."
p8, § 5.3.2, ¶ 3	What is the basis for the statement that "In general, nitrate destruction occurred ...before perchlorate destruction."?
p8, § 5.3.3, ¶ 2	The text states that the microorganisms introduced into the bioreactor were aerobic. How was that established?
p9, § 5.3.3	Was any analysis attempted to relate the actual rates at which reactants and products were consumed and produced to the stoichiometric ratios predicted by theory? Would this type of analysis help identify which chemical species is limiting?
p9, 3rd and 4th ¶	Please explain the relationship between bioreactor flow path and retention time. The 3rd paragraph states that a retention time of less than 4 minutes corresponds to flow through 4' of bioreactor. The 4th paragraph states that a retention time of 5.4 minutes corresponds to flow through 9' of bioreactor.
p9, § 5.3.4	The text discusses the use of DO and ORP to monitor bioreactor performance. Have any other indicators been considered for monitoring reactor performance?

p11, ¶ 2	The text describes Plate 12 as demonstrating that "the top of the ethanol working range...is approximately 140 mg/l ... [and that] at concentrations above 180 mg/l, perchlorate destruction degrades and is incomplete." The statement appears true, but is the cause of the poor perchlorate destruction the high ethanol dose or high influent DO? All of the high ethanol data points (i.e., above 140 mg/l) represent high DO influent water (i.e., before 1/24).
p12, § 5.3.9	Was any attempt made to identify the types of organisms observed in the bioreactor? (e.g., bacteria, yeasts, molds)
p12, § 5.3.10	Was any attempt made to calculate a mean cell residence time? Would such a calculation help determine the time required for the bioreactor to respond to a change in influent conditions?
p13, § 5.4	The text states that "Analytical results shown in Appendix D demonstrate that with an influent ethanol concentration of 60 to 70 mg/l, ethanol in bioreactor effluent was less than the 5 mg/l laboratory reporting limit." This relationship is shown for only a short period. For influent ethanol concentrations between 60 to 70 mg/l, perchlorate and ethanol were reduced to below their reporting limits in only two samples collected over a three day period (2/27-3/1). Subsequent samples (collected on 3/3, 3/4, and 3/5) had perchlorate concentrations above 4 ug/l. Appendix D show that two ketones (acetone and 4-methyl-2-pentanone) were present in the reactor effluent in the hundreds of ug/l. In each of the five days in which EPA Method 8260 results are presented, acetone increased in concentration in the bioreactor. Please discuss the likely source and significance of these ketones. Primary and secondary alcohols are readily oxidized to aldehydes and ketones.

p13, § 5.4 (continued)	Although the acetone does not appear to originate solely from the alcohol, could ketones be present in the alcohol? Was the ethanol analyzed for the presence of impurities or denaturing agents? What information is available from the supplier or manufacturer on the composition of the alcohol? If any impurities are present, are higher grade, more purified forms of alcohol available? We also note that isopropyl alcohol was detected on several occasions between 3/1 and 3/13 at concentrations between 5 and 19 mg/l. Do you believe that isopropyl alcohol was present in the alcohol when purchased, or originated elsewhere? How can its presence be limited in the future? Did the source or vendor of alcohol change over the duration of the study? The text states that "it was concluded that the slightly reducing, anoxic conditions present in the bioreactor are not sufficiently reducing to cause VOC degradation." In all samples analyzed for VOCs , the TCE concentration decreased through the bioreactor - on average by about 75%. What evidence is available to suggest that the decrease is due to carbon adsorption, biological degradation, or some other mechanism? Could VOCs have been lost by volatilization?
p14, 4th bullet	The text states that "laboratory analyses indicated a lack of pathogens that may be of concern..." Is this statement based on any test results other than for fecal coliform?
p14, § 6.0, 5th bullet	This conclusion is overstated. See comment on page 1, 5th bullet.
p14, § 6.0, 6th bullet	The test states that the *conceptual model* agrees well with the actual results. Are you referring to the description of fluidized bed behavior included in Section 5.2? Please explain the ways in which the study results support and/or differ from the *conceptual model.*
Plate 1	Plate 1 includes the statement "Confidential Business Information," yet we understand that the report has been distributed to several agencies and groups without specific instructions to keep any part of the report confidential. Please clarify whether the Steering Committee is claiming Plate 1 or any other part of the report as Confidential Business Information.
page B-2, 6th bullet	The text states that EPA Method 502.2 was used for VOC analysis, but Appendix D lists results for both EPA Methods 502.2 and 8260. How do the two methods compare in their ability to identify and quantify aldehydes and ketones?
Appendix C	Please describe in more detail how the microorganisms were added. Was the sludge added directly to the bioreactor? Or were extracts or isolates used? What provisions were taken to avoid introducing harmful organisms?

page C-4, ¶ 4	The text mentions that the DO profile in the bioreactor was measured before the air stripper was taken offline. Please include these data in Appendix E.
page C-6, ¶ 6	The text states: "Therefore, the range of ethanol concentrations at which complete perchlorate and nitrate destruction is lost lies between 50 and 70 mg/L." The definitiveness of the statement seems unwarranted given the short, one-time test of the relationship. I recommend presenting the relationship between ethanol concentration and perchlorate destruction as a hypothesis in need of further evaluation.
Appendix D	Can the coliform results that are presented as MPN>200.5/100ml be quantified? Please include results from all blanks and replicate analyses.
Appendix D, last page	A metals result on 2/19/98 (for iron) is reported as "TEQUILA." Please explain.

7/28/98 EPA Comments on
Phase 2 Treatability Study Work Plan, Perchlorate in Groundwater, Baldwin Park Operable Unit, San Gabriel Basin

Location of Comment	Comment
p1, col 2, ¶ 3	The text states that: "Finally, the results of the treatability study indicate that the effluent water quality (following disinfection and filtration) should meet all applicable standards..." This sentence should be revised, since the Phase 1 study did not include testing of filtration or disinfection processes, and did not appear to include analysis for all Title 22 water quality parameters.
p3 , col 2, ¶ 3, last sentence	The text states that: "... the microorganisms multiply to a steady-state level, determined by the organic loading to the system." What does the phrase "steady-state" mean here? Doesn't the need for a biological growth control system indicate that microbial growth exceeds death? Don't the rates of microbial growth and reproduction also depend on factors other than organic loading to the system?
p3 , col. 2, ¶ 4	The text states that: "Nonviable microorganisms eventually become detached from the medium and exit the system..." Is there evidence that microbes are exiting the system? If so, is there evidence that the exiting microbes are dead or dying? The text states that "...The reaction takes place under anoxic conditions...," but Appendix E in the Phase 1 report indicates that low levels of DO remain in the bioreactor. Please comment.
p3, § 3	Please explain further the rationale for selection of ethanol as an organic substrate, and discuss other possible substrates.

p4, § 4.0	Phase 2 objectives should be clarified or supplemented to include the following: i) demonstration that perchlorate and alcohol concentrations can be consistently reduced to below laboratory reporting limits (i.e., for much longer than the several day period demonstrated in Phase 1); ii) evaluation of the potential for the production of byproducts of alcohol degradation and cell metabolism and growth. Please comment on the value of isolating and/or identifying the microorganisms present in the bioreactor in order to evaluate the potential for the microorganisms to release toxic substances into the water. Is there a potential for the trace metals present in bacterial enzymes to be released at toxic levels? Is there a potential for changing redox conditions to result in the formation of organic-metal complexes? Is it known whether the microorganisms make use of molybdenum, as do nitrate-reducing bacteria (and the perchlorate-reducing bacterium identified by the Air Force Research Lab), or another potentially more toxic metal?; iii) verification of the Phase 1 finding that vinyl chloride and other unwanted byproducts are not produced in the bioreactor; iv) evaluation of the potential for the treated effluent to cause microbial growth in a drinking water distribution system; v) testing the treated effluent for taste and odor and other secondary drinking water parameters; vi) determination of optimal phosphorous dosage; vii) testing to fully characterize the treatment process' response to plausible operational problems and perturbations (e.g., power outages, interruption of chemical feed, changes in influent composition). The characterization should include the nature of the response (e.g., changes in perchlorate removal effectiveness and other physical and chemical indicators of system performance), recovery time, and evaluation of the need for backup systems. The workplan should include a discussion of the value of adding each of the following objectives, and add objectives deemed worthwhile: i) identification of the active microorganisms in the inoculum and in the bioreactor periodically after startup; ii) identification of microbial nutrient requirements in addition to C, N, and P (e.g., trace metals); iii) evaluation of bioreactor performance using an alternate organic substrate; iv) laboratory analysis of biomass and/or bioreactor effluent for pathogens or other indicators of the presence of pathogens; v) improved understanding of the bioreactor's hydraulic characteristics, in order to better predict the bioreactor's response to changes in influent conditions.

p5, § 4.2, ¶ 1	Please comment on the capability of ion selective electrodes to measure perchlorate and nitrate in water (e.g., Are they capable of reliably measuring perchlorate concentrations in water, but only at high concentrations?). In any case, if improvements in ion selective electrodes are possible in the near future, their use should be reevaluated during design of the BPOU treatment facilities.
p5, § 4.2, ¶ 2	Phase 1 study results show relationships between DO, ORP, and bioreactor performance, but did not demonstrate that "bioreactor performance could be predicted..." It seems premature to claim that all variables significantly affecting bioreactor performance have been identified. What additional work is planned to demonstrate that DO and ORP are good surrogates for perchlorate and nitrate reduction? Which other parameters are being considered for monitoring reactor performance? Has consideration been given to periodically measuring the ratio of perchlorate consumption/cell mass, and determining its relationship to bioreactor performance?
p5, § 4.3, ¶ 1	The text states that "...there is a potential that treated water may contain bacteria..." The bioreactor effluent in Phase 1 consistently had high levels of bacteria. Please comment.
p5, § 4.3, ¶ 2	We suggest that the "characterization of Disinfection Byproducts include a discussion of disinfection options, disinfection location(s), disinfection byproduct (DBP) formation potential, and the relationship between organic substrate and production of DBPs. (Alcohols may produce methyl-bearing aldehydes or ketones that are known to react with chlorine to produce chloroform, a trihalomethane [THM]. Chloroform was measured on 1/28/98 in the bioreactor effluent at 63 ug/l, along with acetone at 6,700 ug/l.). If appropriate, the laboratory reporting limits for alcohol should be reduced.
p6, 1st line [also p10, § 10, ¶ 2]	The text states that "the microorganism inoculum will be characterized." Please describe further. Please describe the origin of the microorganisms in greater detail. If they originate at a baby food processing plant, where in the processing operation are they collected? Please describe the type of environment to which the microbes would have been exposed and acclimated.
p6, § 4.4, col 1	Given that the La Puente VCWD's wells have been shut down for some time, perchlorate concentrations may change after startup as steady state conditions are approached. Should samples be collected at increased frequency during startup to evaluate the bioreactor's performance over a range of influent conditions?
p6, § 5.0	Has the Steering Committee considered operating the 30 gpm pilot scale treatment unit to address some of the Phase 2 objectives, rather than attempting to address all of the Phase 2 objectives at a much higher flow rate?
p7, col 1, ¶ 5	Will the presence and use of ethanol require special equipment beyond the "hazardous duty diaphragm metering pump" mentioned in the text?
p7, col 2	How will samples collected from sampling ports 7 and 8 differ?

p7, col2, *middle ¶*	Please explain further the statement that biomass discharged from the bioreactor will not affect operation of the air stripper.
p8, col 1, ¶ 3	DHS provides the following comments, which may affect the treatment equipment tested during Phase 2: (i) the bioreactor effluent must be approved by DHS as a water source; (ii) post-bioreactor treatment must meet or exceed that required by the Surface Water Treatment Rule (which includes specified removal rates for viruses and other pathogens) ; (iii) a tracer study may be required to demonstrate adequate disinfectant residual and contact time; (iv) a filtration system study will be required to demonstrate compliance with Title 22, Section 64653 if the loading rate specified in Title 22, Section 64660 (b) is exceeded; (v) the treatment train must meet turbidity standards established in section 64653(c); (vi) that issuance of a domestic water supply permit for use of the biological treatment process will, if warranted, occur after a review process subsequent to and separate from the Phase 2 study; Please include dates in the schedule for obtaining DHS approval for use of the bioreactor effluent as a water source; for submission, review, and approval of a filtration system study protocol (to the DHS internal Surface Water Treatment Committee); and for satisfying any other DHS requirements. Also, DHS indicates that coagulation and flocculation may be needed. Please discuss.
p8, col 1	The treatment equipment description does not include provision for establishing a chlorine residual. Please comment. Where in the treatment process will waste sludge or solids be produced? Please describe the nature of the wastes, volumes produced, and methods of handling and/or disposal
p8, § 8.0	The text discusses "key permitting requirements." What other permits are needed beyond those listed?
p8, § 8.2	Please include a timetable for applying for and obtaining a Regional Board discharge permit.

p9, § 8.3	Please include a timetable for obtaining an ATF permit.
p9, § 8.4	Please identify the chemicals requiring certification, and include a timetable for applying for and obtaining certification.
p9, § 9.1, col 2	Please describe the procedure for adding the microbial seed.
p10, § 10	The SAP/QAPP should be submitted for review by EPA, DHS, and other relevant agencies. Sample collection and analysis should reflect additional objectives added in response to the comment on page 4, section 4.0. The SAP/QAPP should briefly describe non-EPA methods and provide complete references. If a reference is not to a commonly-available journal or textbook, a description of the method should be included as an appendix to the SAP.
p11, §10.3	Please supplement the list of analytes to account for the expanded list of objectives. Total Organic Carbon (TOC) should be included. Also note that new or revised MCLs and MCLGs have been proposed for chlorite, trihalomethanes, chloroform, haloacetic acids, and several other chemicals as part of the Disinfectants/Disinfection Byproducts Rule.
p11, §10.4	Given the apparent variability in measured perchlorate concentrations during Phase 1 testing, a sufficient number of replicate samples should be analyzed to better estimate the precision of the analytical method.
p12, sect 11.1	Does the project team include individuals with expertise in microbiology, bacteriology, and related disciplines?
p12, §11.2, last ¶	Please include provisions for frequent interim reporting to EPA after startup (weekly to biweekly). Reporting can be by mail, fax, telephone or email. Please include provisions for less frequent interim written reporting. There is no communications plan in Section 10 as stated in the text.

p12, § 12 (Schedule)	Please add items to schedule as appropriate in response to comments on: p8, § 8.2 p9, § 8.3 p9, § 8.4 p8, col 1, ¶ 3 p10, § 10 p12, § 11.2 , last ¶ The two month design and six month procurement and construction periods appear unnecessarily long. Please shorten and provide a detailed justification for the revised schedule. In addition, incorporate a two week period for DHS/EPA review of the design and O&M plans. We also suggest that you delete the line item for "DHS Operating Permit."

7/28/98 EPA EDITORIAL COMMENTS ON
PHASE 1 REPORT AND PHASE 2 WORKPLAN (Respond at your discretion.)

Phase 1 Report Editorial Comments:

p1, ¶ 1	Metropolitan prefers that their role be described as assisting Three Valley. They request that the 1st sentence be modified as follows: "... U.S. EPA Region IX (EPA) and Three Valleys Municipal Water District (TVMWD), in association with Metropolitan Water District of Southern California (MWD), have been planning..."
p1, ¶ 4, sentence 3	The revised RfD may or may not lead to an enforceable standard.
p1, ¶ 4, last sentence	Other factors, including demands by users of the treated water, may affect the decision whether to treat for perchlorate.
p3, § 2.3	There appears to be an extra "than" in the 1st sentence.
p4, 3rd line	Not all parameters were analyzed for. Suggest deleting the word "all."
p4, § 3.2	The text states that the "...the biomass will be 15 feet high." Presumably, this is the height of the fluidized bed (i.e., suspended carbon granules) with attached biomass.
p5, § 4.0	To support findings made in the text (e.g., relationship between DO loading and perchlorate removal), we suggest you add references to data presented in the Tables. No reference is made in the text to Table 3.
p6, § 5.1	Denitrification is misspelled. Electrical charge doesn't balance in the denitrification reaction. As written, the text incorrectly states that ethanol is converted to chloride and nitrogen.
p8, § 5.3.3	There appears to be an extra "at" at the beginning of the 5th line.
p9, § 5.3.3	The rate constants listed above the arrow in each equation appear superfluous.
p9, § 5.3.3, ¶ 2	There appears to be an extra word ("... reactor bioreactor...") in the 5th line.
p9, § 5.3.3, ¶ 4	In the first line, the word "stripper" is misspelled.
p12, § 5.3.9	Since the microbes were not identified, is there really any evidence that Voltera's principle applies?
p13, sect 5.4, par 4 [and p15, 1st bullet]	The text states that "Testing for VOC degradation products showed no detectable concentrations of VOC degradation products..." Couldn't TCE be a degradation product?

Table 3	We suggest adding a note specifying where the influent DO is measured. It appears that it was measured at port C, after internal recycle.
plate 6	For this and any other figures showing perchlorate concentrations near the detection limit, indicating the quantitation limit on the figure would help the reader correctly interpret the data (i.e., the perchlorate concentration did not necessarily stabilize at 4 ug/l).
page B-1, 3rd bullet	In the 5th line, eductor is misspelled.
page B-2, 1st bullet	In the 6th line, the word "of" is missing.
page C-2, ¶ 4	Some words appear to be missing from the last sentence.
page C-4, ¶ 3	In the 1st line, should the sentence be corrected to state that the ORP decreased (rather than rose)?
page C-4, ¶ 5	The last line in the paragraph states that the DO was reduced to a range of 9.5 to 1 mg/L. Should the 9.5 mg/L be 0.95 mg/L?

Phase 2 Report Editorial Comments:

p2, §2.0	EPA has established a Reference Dose, but has not established an acceptable level for perchlorate in water.
p3, § 2.2, ¶ 2	After completion of the toxicological studies, the RfD may no longer be "provisional." Suggest deleting the word provisional.
p3 , col. 2, 1st line	There is a comma missing after the word "chloride" in the 1st line.
p5, col 2, 2nd line	Volt is usually abbreviated with a capital V.
p6, 1st sentence	Inoculum is misspelled .
p9, § 8.5	We suggest that you delete the phrase "Phase 2 Treatability Study" in the second line.
p10, § 10.0, ¶ 2, line 4	Inoculum is misspelled
p11	No need to repeat the list of ten sample locations twice in the report (pages 7 and 11)